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Percutaneous Radio-Frequency Rhizotomy in the Treatment of Trigeminal Neuralgia

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A percutaneous technique of selective partial trigeminal root coagulation was evaluated in the treatment of 38 patients suffering from trigeminal neuralgia, 1 patient with pain secondary to oral carcinoma and 1 patient with atypical facial pain. The pain of trigeminal neuralgia was relieved in 94.7 percent of patients. Pain was relieved in the patient with oral carcinoma, but not in the patient with atypical facial pain. There was no mortality and no permanent morbidity outside of the trigeminal nerve lesion. The procedure requires only a brief hospital stay without the time, expense and hazards of open cranial surgical procedures.

TRIGEMINAL NEURALGIA (tic douloureux) is one of the most painful affiictions known to man. In order to relieve the sufferer, peripheral branches of the trigeminal nerve, the Gasserian ganglion and the trigeminal root have been interrupted surgically or by the injection of toxic agents.[1] Medications such as carbamazepine (Tegretol®) or phenytoin (Dilantin®) have reduced the frequency and severity of the pain attacks in many patients but with a considerable failure rate as well as a high incidence of unpleasant side effects.[2]

Although craniotomy with partial section of the trigeminal root or removal of compressing vessels affords lasting relief from trigeminal neuralgia, it does require a general anesthesia, open cranial surgical operation and a time-consuming and expensive hospital stay. A percutaneous technique has recently been introduced[3,4] that is as effective in relieving tic pain as the open surgical therapy. We have used this procedure in 40 patients at Stanford and have been impressed with its safety and effectiveness.

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Method

The method we use differs only slightly from that previously reported.[3-6] The patient is brought to the operating room awake and alert. No premedication is used. A peripheral intravenous line is placed. Electrocardiograms and pulse are monitored. A portable image intensifier is positioned to give a true lateral picture of the skull. The appropriate side of the face and adjacent shoulder are prepared with betadine antiseptic. A point (A) is marked on the cheek at the intersection of a line dropped perpendicularly down the cheek from the inner edge of the pupil with a line joining the external auditory canal and the top of the nasolabial fold. A second point (B) is

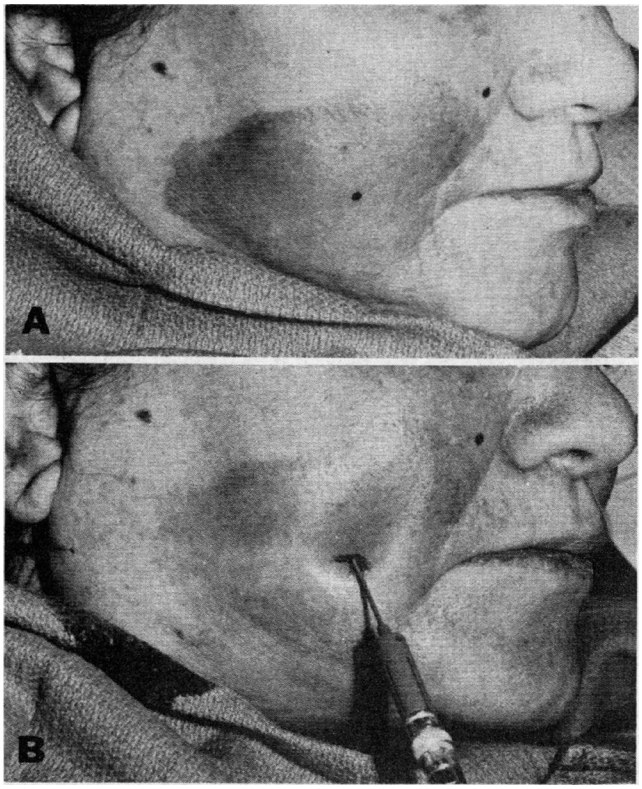


Figure 1.—A, The three coordinates are marked on the face of a patient. **B,** The needle electrode has been inserted and advanced along the coordinates to penetrate the foramen ovale.

marked 3 cm in front of the external auditory meatus. A point 2.5 to 3 cm lateral to the angle of the mouth is injected with a 0.5 percent solution of xylocaine and a xylocaine wheal is raised on the shoulder (Figure 1A).

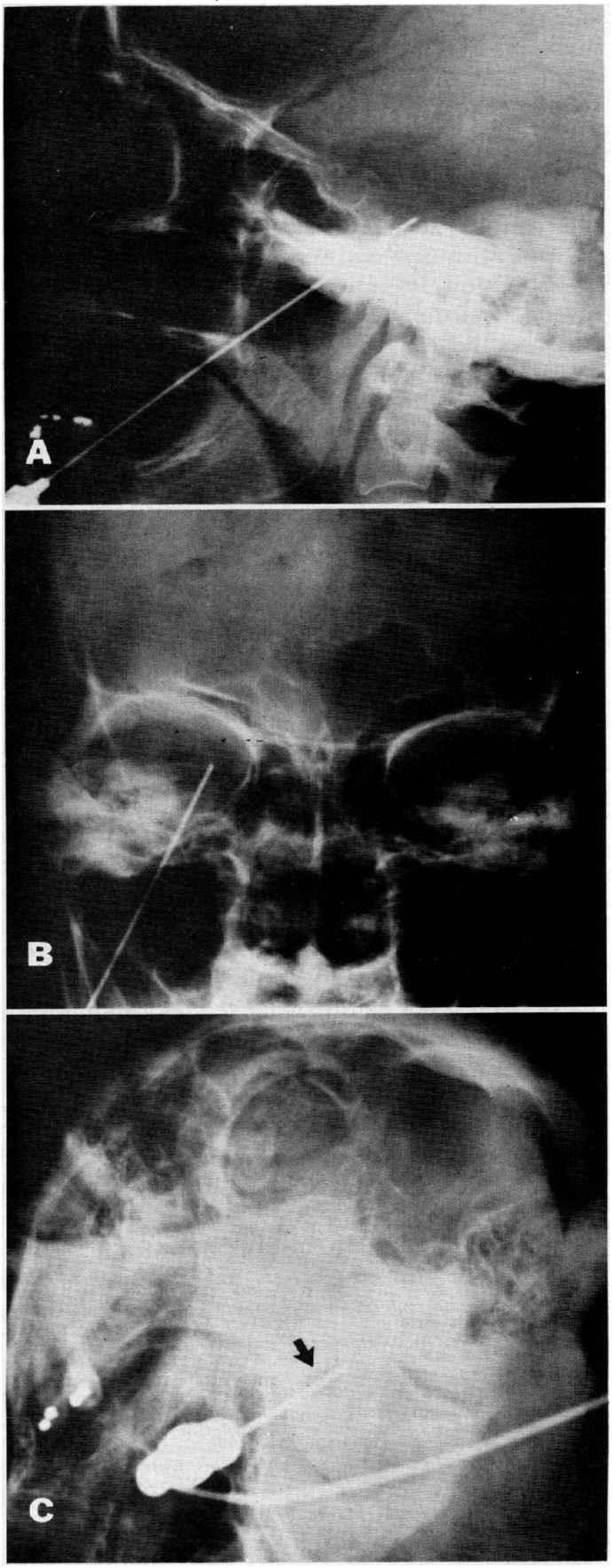
A disposable spinal needle inserted into the shoulder acts as the ground electrode. The patient is then briefly anesthetized with intravenous administration of methohexital (Brevital®), 30-60 mg., while a needle electrode (Radionics Type TIC Kit, Radionics, Inc., 76 Cambridge St., Burlington, MA 01803) is inserted at the point lateral to the corner of the mouth. A finger in the mouth guides the needle through the soft tissue of the cheek between the skin and mucous membrane as it is advanced medial to the ramus of the mandible towards the base of the skull. In order to penetrate the foramen ovale, the needle is directed towards a point at the intersection of lines projected posteriorly from point A in the sagittal plane and medially in the coronal plane from point B (Figure 1B). The needle is advanced under x-ray control through the foramen ovale toward the junction of the clivus and the petrous ridge as seen on the lateral fluoroscopic image (Figure 2A). As the needle is advanced, spinal fluid is usually encountered. The needle is positioned a few millimeters in front of the clivus for third division pain, at the clivus for second division and a few millimeters beyond the clivus for first division. The portable image intensifier is then rotated to check the needle position in the anteroposterior projection (Figure 2B) while the patient is waking up from the methohexital.

If there is any doubt as to the location of the needle, a submental vertex view is obtained to be certain the needle has penetrated the foramen ovale (Figure 2C). Repetitive pulse stimulation at 50 cycles per second with 200 to 500 mV (Radionics generator model RFG-3AV) will allow the patient to tell what portion of the nerve is being stimulated. After adjustment of the needle position, a graded destruction of the appropriate rootlets is carried out using a heat lesion. Use of 60°C for 60 seconds usually just starts a lesion that can be tested for with a safety pin. In most patients another dose of methohexital is needed, usually 20 to 40 mg, during this portion of the procedure.

Additional destruction, usually at higher temperatures for shorter periods, is frequently necessary to render the pain trigger zone and a portion of the appropriate division permanently hypalgesic. We use 70° to 75°C for 10 to 30 seconds with frequent testing of the patient's response to pinprick as a guide. After the initial lesion or two, pain sensation is frequently sufficiently dulled so that further increments of methohexital either are not required or are needed in a much reduced dose. We try to avoid dense analgesia, limiting the lesion to a blunted appreciation of the pinprick in the required areas.

Results

Forty patients with facial pain were treated with percutaneous radio-frequency rhizotomy and their conditions followed for from two months to three years. Of these patients, 38 had trigeminal neuralgia. One patient had atypical facial pain and the last suffered pain secondary to carcinoma of the tongue and floor of the mouth. The mean age was 63 years (range: 28 to 86 years). There were 12 males and 28 females. Pain was present on the right side in 20 patients and on the left side in 19. One patient with multiple sclerosis had bilateral facial pain.



Of the patients with trigeminal neuralgia, 19 had pain in a single division and 19 had pain in more than one division. The most common single division affected was V_2 (11 patients), but pain affecting both V_2 and V_3 was the most common combination seen (12 patients).

The average duration of trigeminal neuralgia was 8 years (range: 7 months to 25 years). Nearly all patients had previous treatment, including therapy with carbamazepine (37 patients), phenytoin (15 patients), alcohol blocks (18 patients), peripheral neurectomies (8 patients), craniotomy (4 patients), acupuncture (2 patients), and unsuccessful attempts at percutaneous rhizotomy at other institutions (2 patients).

Complete pain relief occurred in 37 of our 40 patients (92.5 percent) following percutaneous rhizotomy. In five patients (13.5 percent) a second lesion was required because of recurrent trigeminal neuralgia. This usually occurred two to eight weeks after the first procedure. A repeat lesion resulted in lasting relief of pain. Of the 38 patients with trigeminal neuralgia, 36 (94.7 percent) were finally relieved of their pain.

In three patients pain was not relieved by the procedure. In one woman with congenital scaphocephaly, we were unable to penetrate the foramen ovale because of a pterygoalar bar.[7] She subsequently had an open root section which has relieved her trigeminal neuralgia. In another woman with trigeminal neuralgia who had had previous neurectomies for V_2 distribution pain, we were unable to get pain relief despite an increase in numbness within the distribution of V_2. The patient with atypical facial pain was also not relieved by this procedure.

There were no deaths in this series. Thirteen patients were over the age of 70 and all tolerated the procedure well. There was one patient in whom the carotid artery was punctured. The needle was withdrawn and redirected more anteriorly and laterally to enter the foramen ovale rather than the foramen lacerum and the procedure continued. The patient's trigeminal neuralgia was relieved and there were no sequelae

Figure 2.—A, A lateral x-ray showing the needle electrode in position. Its tip lies just beyond the junction of the clivus and petrous ridge shadows. **B,** An anterior posterior projection showing the electrode just medial to the internal auditory meatus at the depression in the petrous ridge over which the trigeminal root courses. **C,** an oblique submental vertex view to show the electrode passing through the foramen ovale **(arrow).**

to the carotid puncture. In two patients cheek hematomas developed during the procedure, but there was no associated morbidity. The most serious complication was the development of a streptococcal meningitis one week after the procedure in a patient in whom the buccal mucosa was inadvertently punctured during passage of the needle to the foramen ovale. He was treated with antibiotics and recovered. Another patient had a mild aseptic meningitis secondary to a small amount of blood in the subarachnoid space following the procedure. There have been no cases of anesthesia dolorosa. Five patients had a decreased corneal reflex after the procedure, but none have had corneal complications. Two patients had significant ipsilateral masseter muscle weakness, both have since improved.

Discussion

It was initially hoped that by using a graded heat lesion, selective destruction of the pain-carrying A delta and C fibers within the trigeminal root could be accomplished with only minimal sensory loss.[4] Unfortunately, it has become apparent to us, as it has to others,[5-7] that there is a clear trade-off between the degree of analgesia produced by this procedure and the incidence of recurrent trigeminal neuralgia. The more restricted the sensory deficit, the higher the recurrence rate.

However, the more dense and widespread the anesthesia, the more likely it is that the patient will experience annoying or distressing dysesthesias in the area of numbness (anesthesia dolorosa). Since it is so safe and simple to treat recurrence by further percutaneous rhizotomy, while there is no effective treatment for anesthesia dolorosa, we initially make a small lesion which renders the trigger zone hypesthetic (blunting of a pinprick) without producing dense anesthesia. We accept that there will be an incidence of pain recurrence that will have to be treated by further rhizotomy.

The complications encountered have been gratifyingly few considering the age and associated medical problems of our patients. The one case of bacterial meningitis should not have occurred since it was clearly due to a break in technique. Fortunately, the patient's condition responded promptly to therapy with antibiotics and the patient recovered without sequelae. We had no mortality and no other significant morbidity outside of the trigeminal nerve. Of the complications involving the trigeminal lesion, the most dangerous is first division anesthesia leading to neuroparalytic keratitis. One tries to avoid significant first division sensory loss in any patient whose pain and trigger zone does not involve first division fibers, and with experience and patience, this can be achieved. The problem is in those patients with first division tic in whom a subtotal first division lesion must be made. For some reason, first division fibers seem to be more sensitive to the radio-frequency lesion than second or third division rootlets, and we have seen the lesion progress with remarkable rapidity in some of these patients. Fortunately, we have not yet had a case of keratitis occur. Weakness of the ipsilateral muscles of mastication is not an uncommon complication of the procedure. Curiously, patients do not seem to notice a unilateral motor loss. Regeneration is the rule and motor power improves with time.[5,8]

Damage to the carotid artery, the extraocular motor nerves and the ipsilateral temporal lobe has been reported by others.[5-8] Fortunately, these complications are extremely rare and usually occur only if the radiographic guidelines above are not rigidly followed.[6] As others have noted,[8,9] atypical facial pain is not helped by this procedure and it remains a treatment dilemma. In summary then, percutaneous radio-frequency trigeminal rhizotomy is a safe and effective treatment for trigeminal neuralgia, requiring only a few days in hospital. With experience and patience, pain relief can be achieved with only minimal risk and discomfort to the patient.

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